Crowley (D.D.)

A Rapid Method of Locating Intestinal Wounds by the Use of Hydrogen Gas and an Antiseptic Fluid.

BY

D. D. CROWLEY, M. D.,

Oakland, Cal.

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A RAPID METHOD OF LOCATING INTESTINAL WOUNDS BY THE USE OF HYDROGEN GAS AND AN ANTISEPTIC FLUID.

By D. D. Crowley, M. D., Oakland, Cal.

Read before the California Academy of Medicine.

Up to the present time it has been the custom of surgeons when called upon to treat penetrating wounds of the abdomen with accompanying symptoms of serious injury to the viscera to perform a laparotomy and inspect the important structures.

That part of the viscera which most often tries the patience of the operator in his search to determine the presence or absence of wounds, is the digestive tract, for usually a moderate-sized wound, one-fourth to one-half inch in length, sufficient in magnitude to cause death, may elude the vigilance of the operator for one-half to three-quarters of an hour, or longer, and when found he is not certain that another may not be present.

The usual method in such an exploration has been to carefully pass the intestine through the fingers, beginning at the pyloric end of the stomach and ending at the sigmoid flexure. The stomach, too, is raised and depressed to ascertain if it be wounded. Valuable time is employed in such an examination—time that diminishes the chance for the recovery of the patient in proportion to its protraction, and it is certain that the excessive manipulation of the gut aids considerably in producing shock, and often death.

In this paper it is not my intention to consider the advisability of operative interference in penetrating wounds. I consider that certain symptoms which usually follow a dangerous wound will impress the observing surgeon as to the advisability of using the knife. I will therefore limit my remarks almost entirely to a method for quickly locating wounds in the intestines or stomach by the employment of hydrogen gas forced into the rectum, and a weak carbolized solution poured through the abdominal wound upon and covering the intestines. This I have already described (Medical Times, vol. VI, p. 24), but I am now able to present the results of a much larger experience with it.

To elaborate slightly upon the subject, it may be understood it is the rule, when the abdomen is freely opened for exploration, that the intestines are prone to escape from the peritoneal cavity or at least roll up above the surface of the wound, but this does not prevent a carbolized solution being poured into the peritoneal cavity, until it is filled. Gas can be insufflated into the rectum until bowels and stomach are distended, if they are not wounded. If the intestine be wounded, the gas escapes in proportion to the size of the opening. When this is large,

the intestine is only distended from anus to wound, the gas then passing into the peritoneal cavity. When the opening is small, the gas escapes in quantity sufficient for diagnostic purposes, but may pass the wound and inflate the entire digestive tract. When two or more wounds exist, the gas will, by preference, escape from that nearest the rectum. If the intestines are forced by the hand of the operator below the surface of the solution, the gas will appear as large white bubbles ascending through the fluid. These bubbles will direct him immediately to the point of escape from the intestine. The wound being sutured, the gas is again insufflated, and if bubbles no longer appear it is positive proof that the wound is properly sutured, and that no other intestinal lesion exists.

The antiseptic solution and hydrogen gas as a diagnostic medium, are, without question, certain and rapid in their office, shortening to a minimum the time used in exploration, and positively demonstrating the presence or absence of any penetrating wound of the intestinal tract. If, then, no harm follow their use, or if they do not act as a hindrance to returning the intestines to the cavity, to completing the peritoneal toilet, or with the apposition and repair of tissues, and in a general way retard the recovery of the patient, they should certainly be used when intestinal wounds are suspected.

To definitely determine these points, I used a number of dogs, upon which I could follow a line of investigation from the reception of the injury until the termination of the case—a line of investigation that is quite impossible on the human subject, owing to the limited number of such cases and the impossibilty of gleaning aught but an imperfect history of any case unless death should ensue.

Experiment 1.—Hound; bitch; weight 20 pounds. May 18, 1892. Anesthetized. Shaved abdomen, and prepared surface for operation by washing with carbolized solution and covering greater part of surface with warm, moist carbolized cloth, leaving bare, only, the linea alba for a distance of 5 or 6 inches. Made an incision in the median line through muscular tissue to peritoneum, also slit peritoneum sufficiently to introduce fingers, after which this membrane was torn until its wound equaled the external. The intestines now being exposed, an assistant was directed, while I was not observing him, to make one or more wounds through their walls, as distant from the surface as possible. I then proceeded to discover the wound or wounds by inserting the rectal tube which was connected with the hydrogen bag, and after slight pressure of the foot on the gas bag had been maintained for four or five minutes, the intestines and stomach became inflated. Warm, weak carbolized solution was poured into peritoneal cavity while intestines were becoming inflated. During the greater part of this time the abdominal viscera were protected by warm, moist, antiseptic cloths, which were drawn aside when the solution was poured upon the intestines. By slight pressure of the hand the intestines were fairly submerged, and a spluttering or disturbance of the fluid ensued, which directed my attention to the left

iliac region. Raised a couple of coils of intestine from that location, the gas escaping from the bowel through the fluid quickly guided me to a wound about ½ inch in length. This was sutured, and the loop returned, after which the external wound was covered with warm carbolized cloths, and the digestive tract again inflated. More fluid was poured into the peritoneal cavity; bubbling and spluttering followed; the intestine in its immediate vicinity was raised and a wound discovered, which was treated as the first. A third insufflation demonstrated a third wound, but the fourth insufflation only distended the intestines and stomach, and, as no gas escaped through the fluid while the intestines were submerged, the abdominal wound was sutured without further explorations. The sutures included all of the tissues. A few superficial sutures were also used to more accurately appose the integument. The wound was dressed antiseptically. From the time the animal was anesthetized until antiseptic dressings were applied, was about 60 minutes. It required 15 minutes to make 4 insufflations of gas, 6 minutes for the first and 3 minutes each for the 3 last. After the cecal valve has been once dilated by gas, it requires a much shorter time thereafter to distend the entire tract. The time required to locate wounds after intestines were inflated was 6 minutes, or about 2 minutes to each wound. The animal was not eviscerated; as only a few coils of intestine protruded from the abdominal wound, and these were protected by warm, moist, antiseptic applications. The intestines remained slightly unprotected during the six minutes of exploration, and to a much less degree while suturing the wounds. The warm carbolized water introduced from time to time into the cavity had a tendency to keep the intestines at a uniform temperature. Its diagnostic assistance is most marked. For while gas will produce a sound in its escape from a small aperture, it causes a marked disturbance in the water, which I designate as a bubbling or spluttering. There was but little difficulty in returning the intestines, and no decided hindrance to suturing the abdominal wound. In returning the intestines considerable gas was forced from them through mouth and rectum by the pressure of the hand.

May 19th—Owing to escape of gas from intestines during night, and the resulting diminution of the body, the dressings were only poorly in contact with wound. Removed draining tube and redressed wound. May 23d—Six days after operation removed dressings and sutures. The latter had cut through the tissues ¼ inch and a few were only attached to one side of the wound. By moderate pressure of the hand, forced through stitch holes and small aperture from which drainage tube had been removed, a bloody fluid, which did not appear to be septic. Carefully redressed with oakum, absorbent cotton, and other protectives. Iodoform was thoroughly rubbed into wound. Temperature, 98°. Drank quite freely of milk. Could walk easily if it were not for bandages interferring with the movement of hind legs. May 30th—Redressed wound as usual. Dressings saturated with a purulent fluid. Sutural paths not entirely repaired. Abdominal incision united, except possibly at point where drainage tube had been. June 24th—Dog in good health, and heavier by several pounds than when operated upon. Killed with chloroform, and after several experiments carefully examined intestines. Of the three wounds that had been sutured, there was nothing to point out their location except a thickening of intestinal tissue, and at one place an angular position of the intestinal wall. No sutures could be found, and

the lumen of the intestine, that at first must have been reduced one-third, had now attained its normal size. This proves that small wounds of the intestines are not always followed by a material diminution of the lumen. The passage of the intestinal contents acts on the walls during repair much the same as a sound upon the urethra in remedying a stricture. This dilatation of the intestines does not begin to take place until the second or third week. There were a few adhesions between the intestines and between the intestines and abdominal wall, but they were not extensive, and so far as I could judge would not interfere with the function of the bowel.

I have introduced the various steps in this experiment for the purpose of making the subject of the paper clearer. Many of these will not be touched upon in describing further experiments.

EXPERIMENT II—May 20, 1892—A small mongrel terrier bitch. Resisted anesthesia and died in a few minutes after its improper administration. As this did not necessarily interfere with the principal object of the experiment, that of locating intestinal wounds, the abdomen was shaved, and the usual steps were employed in exposing to a necessary extent the abdominal viscera. Made four incisions in the intestines, two upon the convex surfaces and two near the attachment of mesentery. Dr. Rogers, who has assisted in nearly all my experiments, at my request, carefully examined the intestines in order to locate the wounds, he being uninformed as to their number or location, and found the two on the convex surface, and sutured them. The time occupied was three-quarters of an hour. Upon further investigation he decided that no more wounds existed, but desired to use the gas to substantiate his decision. The hydrogen gas was at least ten minutes in passing the ileo-cecal valve, owing to some pathological obstruction. In 2 or 3 minutes a small wound was discovered near the valve, and after suturing it a second wound was located in 3 or 4 minutes. In locating the last two wounds, bubbles could be easily seen rising rapidly through the fluid. While making this investigation it was also ascertained that a sutured wound permitted gas to escape, and by holding it under the fluid the faulty point, though not larger than a pin's head, could be distinguished by the course of the bubble. In concluding this experiment, one of my associates made a wound for me to discover. I did so within two minutes, *i. e.*, found the intestine from which the gas issued; yet so obscure was the wound that it was necessary to again submerge it in order to discover the exact location, as it was made where the mesentery was attached to the intestine, the wound in the mesentery being the smallest that could be made by a small-bladed knife, while the deeper or intestinal wound was about one-half inch in length.

EXPERIMENT III.—May 24, 1892, 11 A. M. Small, yellow bitch. After the usual preliminary antiseptic precautions and anesthesia, stabbed the abdomen twice with a sharp pointed knife, in the umbilical region, each wound penetrating the peritoneal cavity. This was done for the purpose of endeavoring to wound the intestines. Opened the abdomen in the median line to the extent of five inches, and examined intestines for wounds; finding none, filled cavity with carbolized solution and injected gas, which at the end of eight minutes passed the ileo-cecal valve. This demonstrated that no wound was present. While

abdomen was opened, assistant made a wound in intestine and returned it, and although less than ¼ inch in length, it was located in one or two minutes by the use of hydrogen gas and carbolized water. It was secured with three stitches. The peritoneal cavity was carefully sponged out and abdomen closed as in the first experiment. May 25, 1892—Removed dressings and drainage tube and redressed antiseptically. Dog inclined to lie down most of time. May 30th—Redressed wound after removing stitches. Abdominal wound fairly united, and suture paths very small. Small opening communicating with peritoneal cavity when drainage tube had been removed. Dog quite strong and able to walk about. June 3d—Died during night. Examined abdominal cavity and found a general peritonitis. Intestine undergoing dissolution, necrosis of tissue so extensive as to produce perforation of intestinal wall. The most extensive inflammation was in the vicinity of a tumorous mass composed of intestines, one loop closely adhered to another until a globular mass was formed. After pulling the coils apart, a large pledget of cotton was found within, which had been left in abdomen May 24th. When abdomen was first opened, the cotton was surrounded with a quantity of pus, but the pus and cotton was thoroughly separated from the cavity, excepting small apertures that had been recently formed, through which the peritoneal cavity was infected. The wound made in the intestine on May 24th was united, and the stitches fairly covered with firm lymph.

EXPERIMENT IV.—Large, yellow bitch. Anesthetized, and shot through abdomen with 32 calibre pistol. Wounds caused by bullet in skin, small; very little hemorrhage issuing from wounds. Opened abdomen, and without the assistance of gas could readily discover several wounds in the intestines. Three in the small intestine, and one completely severing the bowel; two in the mesentery, from one of which a sufficient hemorrhage took place to fill the abdominal cavity. One-half inch of the cecum was cut away, and a large and small wound were found in the sigmoid flexure. The spleen was also wounded. Working with all the rapidity possible, all of the wounds could not be sutured within two hours. The source of hemorrhage could not be ascertained without drawing many of the intestines from the cavity. The animal died before the operation was finished and before there was any necessity of using gas and water for diagnostic purposes. Cause of death was hemorrhage and shock. The anesthetic might also be claimed as an aid. In this instance the animal should have been immediately eviscerated and the bleeding vessels secured.

EXPERIMENT V.—June 24, 1892. After sacrificing black dog by anesthesia, an anterior incision was made communicating with viscera. The intestines were brought into view, and one was wounded sufficiently to introduce a finger, and then returned. Hydrogen gas was inflated *per rectum*. It passed the ileo-cecal valve in five minutes, and within another minute the small intestines were distended. These were submerged, and small bubbles of gas arose rapidly through the fluid, guiding the operator to the wound.

EXPERIMENT VI.—July 7, 1892. Small bitch, weight 15 to 25 pounds. Anesthetized, and stabbed abdomen in three different places. Opened cavity by a 3-inch median incision, and discovering a serious hemorrhage, gave immediate attention to it by drawing several coils of the intestine into abdominal wound. This permitted a ready examination of

the mesentery, and a wound was quickly found at its union with the intestine. This included the serous and muscular coats of the intestines, ½ to ⅔ inches in length, a small slit in mesentery, and a divided artery. The wound was sufficiently approximated by the employment of three sutures in the intestine and two in the membrane, one of the latter acting as a ligature to the severed vessel. The diagnostic elements gave negative results. Wounded the intestine and proved the efficiency of gas and fluid. Sutured wound and closed abdomen. July 10th.—Removed dressing and drainage-tube. No sutures removed, though there was slight suppuration in sutural paths. Redressed with carbolized gauze, oakum, and absorbent cotton. Since the 8th the animal has been able to walk and has relished milk. July 22d.—Sacrificed dog and removed specimens. The cicatrices were thicker and less elastic than elsewhere. Two sutures were loosely protruding into the lumen of the gut. None could be seen on the serous surfaces.

In this instance it required manual manipulation of the intestines to reach the divided blood-vessel, and thereafter the use of gas and fluid to prove the presence or absence of wounds in the hollow viscera.

EXPERIMENT VII.—Dog. July 10, 1892. Anesthetized, and opened abdomen. Dr. Richardson wounded intestine. It required 5 minutes for the hydrogen gas to pass the ileo-cecal valve, after which the moist antiseptic towels were removed from the abdominal wound, and the intestinal wound sought for. This was discovered in 30 seconds. A second and third wound were made, and each was located within the space of a minute by the bubbles of gas. A very small wound was next made in the posterior surface of the stomach, the intestinal wounds being sutured, the gas quickly distended it and escaped from the mouth without demonstrating the presence of a wound. Upon raising the stomach from the adjacent posterior tissues, the gas quickly escaped and the viscus collapsed. Animal sacrificed and specimens removed.

EXPERIMENT VIII.—Bitch; July 20th. Anesthetized. Opened abdomen with usual precautions, and wounded intestine in three places, and stomach in two. It required 10 minutes for gas to pass the ileo-cecal valve. This was principally due to the large amount of fecal matter in colon. Within one minute after gas had entered small intestine, a wound was located, and after suturing, a second wound was discovered in about the same time. It required about two minutes to locate the wound on the anterior surface of the stomach, but the posterior wound, which was valvular, did not permit gas to escape. This, however, would not have required surgical interference, as the wound in the outer coat did not exceed ¼ inch, and that in the mucous surface ⅛ inch in length, and a probe could not be passed through the wall of the viscus.

While gas and fluid may in any case be used without harm to the patient, where a wound of the intestine is suspected, I must admit that so far I have had no experience with them upon the human subject, but have used them entirely upon the lower animrls, and from these experiments have made my deductions. Hydrogen gas as first proposed by Senn has been employed for several years in the diagnosis of intes-

tinal wounds, but the conjoined use of fluid for this purpose is original, as far as I am concerned, in my experiments.

Several cases of penetrating abdominal wounds have come to my attention in the past two years. In none of these was laparotomy performed, and the patients recovered. In one of these a patient received a large wound in the abdomen by the single thrust of a butcher knife, but had apparently recovered in 8 days, though a portion of the omentum had been cut away and 8 to 10 feet of the intestine was drawn through the wound for inspection. Gas and carbolized water were not used.

In 1890 I committed an error which has been mainly the cause of my special interest in intestinal surgery. The patient, a woman about 50 years of age, and exceedingly fleshy, was brought to hospital with a serious wound in the neck, severing the trachea and esophagus. There was also a wound in the abdominal parieties 6 inches in length, through skin and fascia, and only 3 inches in the peritoneum, having the appearance of a single thrust of a knife, as was subsequently proven at the inquest.

In this case I was assisted by two other physicians, and after carefully examining the intestines in the vicinity of the wound, none of which were found to be injured, the abdominal wound was closed. The patient died. At the inquest, a witness stated that she saw patient stab herself, then thrust her hand through the wound, draw forth a long coil of intestine, cut it off and throw it in the water closet. Though no credence was given the statement, I proved to myself that it was correct, by obtaining the coil of intestine and performing a *post-mortem* examination. In this instance hydrogen gas and an antiseptic fluid would have quickly demonstrated a wound in the intestine, and though the discovery would not have saved the patient, it would have saved the surgeon considerable mortification.

From a careful consideration of these experiments, and of others previously conducted, I have arrived at the following conclusions:

1. Large fecal accumulations materially hinder the insufflation of hydrogen gas, usually increasing the time required to pass the ileo-cecal valve by 5 to 6 minutes.

2. Fecal accumulations also obstruct the point of the rectal tube, and may at times prevent the gas passing into the rectum.

3. Insufflation of hydrogen gas does not materially hinder the suturing of the abdominal wall, nor does it force the intestines from the abdomen during insufflation, as is often stated.

4. The carbolized solution employed answers two purposes, by removing blood and other extraneous matters, and by acting as an element through which the escape of gas from an intestinal wound becomes visible.

5. The use of gas alone reduces the time required in exploring the abdomen for intestinal wounds at least 75 per cent., but with the addition of an antiseptic solution the time can be reduced 90 per cent.

6. With gas and fluid no difficulty is experienced in ascertaining the presence of the smallest wound in the intestine.

7. A wound ⅓ to 1 inch or more in length, in any part of the stomach, may be located by these means.

8. A small wound, ¼ inch in length, on the posterior surface, or a small valvular puncture in any part of stomach, is not always readily located by the use of gas and fluid; but these two exceptions, as I have ascertained, usually do not require surgical interference.

1068 Broadway.

Discussion.

DR. D. W. MONTGOMERY, said the experiments were excellent, and several good points were brought out. For instance, the length of time it took the gas to reach or pass the ileo-cecal valve through the feces. Ten minutes is a long time in an operation, but it is well spent if we know that it takes that time and we get the desired results. He asked Dr. Crowley why the gas did not pass through a wound in the stomach, was it due to the intricate arrangement of the structures of the wall or to muscular contraction?

DR. J. F. MORSE said it seemed that Dr. Crowley's experiments gave us definite means to locate wounds of the intestines in the human body. Quite frequently a wound of the intestine, even a gun-shot wound, would escape careful search. He thought, however, that Dr. Crowley's plan would be difficult to carry out in the human subject, as in order to observe the bubbles of gas that arise through the carbolized solution, the surgeon would be compelled to make an immense incision in the abdomen; if such was the case, it would be very difficult to keep the intestines in the cavity, fill the cavity with fluid, and when the intestines become inflated, keep them under the fluid. He thought Senn spoke of this, but that he lit the gas as it escaped. This method would be better, as there was not the risk of burning your patient.

DR. WM. A. MARTIN asked if it were not possible that the gas might escape into the esophagus, thus preventing its escape through any wound of the stomach, as under an anesthetic the sphincter would be relaxed.

DR. H. KREUTZMANN thought this was of great importance in gynecological work, as in laparotomies the intestine might quite frequently be wounded and escape observation. He recalled one case in Vienna that died from a perforation of the intestine that had been overlooked. The method would also be useful where adhesions were present and the bowels were much handled. For his part he would use boiled water instead of carbolized water to fill the abdominal cavity.

DR. L. ROBINSON asked Dr. Crowley what was the strength of the carbolized water used?

DR. D. W. MONTGOMERY said he remembered a case in New York,

under the care of Dr. Bull, where seven wounds of the intestine were located and sewn up, the case ending favorably.

Dr. Jas. Simpson spoke of a case where the patient had been gored by a bull, causing a severe lacerated wound of the intestine, which healed nicely. He asked Dr. Crowley how he treated intestinal perforations when he had located them.

Dr. Crowley, in replying, said he believed that the non-escape of gas from the stomach in case of small wounds was due to muscular contraction. He had observed the phenomena several times in his experiments. Regarding the strength of the carbolized water, he had used a ½ per cent. solution. He did not see any reason why a human being should not recover from this operation as well as a dog. A dog will throw itself about, get the bandages disarranged, dirtied, and soiled with urine, which was not so with a man. He could not see why the belief existed that a dog would recover better than a human being. As regards the time wasted, there need be none; the gas can be forced up the bowel while the surgeon is making ready for the operation, and as it usually passes the valve in five minutes, this is not so long to wait. In his first experiments a year ago, in a few cases it took ten minutes to reach the valve. The gas and water test required some dexterity, and he believed no surgeon should operate until he had practised on the lower animals. He made a two or three-inch incision, and by the hands, guarded by a warm, moist towel, the intestines could be kept in, and the bubbles would guide the operator to the wound. Regarding the escape of gas by the esophagus, it depends on the degree of anesthesia. If the dog is dead, then the gas passes quickly; if deeply anesthetized, rather quickly; if lightly, the stomach will dilate pretty well. Hydrogen gas had been used, as it is lighter than others, and inflates quicker. In the treatment of intestinal wounds he used silk, and the Lembert suture.

Dr. Morse thought that the subject of intestinal surgery should be discussed at the next meeting. There was an immense amount of literature on this subject. Billroth, he believed, reported fifty or sixty cases last year. Members could look the matter up, and no doubt do it justice at the next meeting. He also thought it would be very interesting if Dr. Crowley could demonstrate his method before the Society.

The Localization of Intestinal Wounds by Means of Hydrogen Gas and Fluid.

At the meeting of the Academy of Medicine, held September 17, 1892, Dr. D. D. Crowley, by request, demonstrated on a dead dog the localization of intestinal wounds by means of hydrogen gas and fluid. He stated that in the dead subject the hydrogen gas escaped freely around the rectal tube, as well as by the mouth; the anus should, therefore, be held firmly against the tube. It requires four or five minutes for the gas to pass the ileo-cecal valve, during which time the bowels can be manipulated. When the intestinal wound is found the rest of the bowel is returned, and a warm towel wrapped about the part to be operated on. Fecal matter will escape. This can be prevented during the operation by simply putting a common rubber elastic band around the gut, an inch or so from the wound, and on each side of it. A small hole in the mesentery can be punched out, that the elastic

ligature may be passed. These are tied, or secured sufficiently to prevent the passage of feces, but not tight enough to strangle the blood supply. The gut can then be washed out through the wound by means of an ordinary syringe. In closing the intestinal wound, the speaker places the first suture near the centre of the opening, through the serous and muscular coat. The next one is placed equi-distant from the first and the end of the wound They are then cut off close to the knot. By sewing properly, the sutures should be about one-eighth of an inch apart. A wound of the kind shown (incised) should be followed by recoverv, unless some complication set in. In about four days the sutures would become covered with a plastic exudation, which, in a week, would hide them, and in two weeks, they would begin to slough into the interior of the gut, and in three or four weeks, no suture could be found. Another point he wished to bring up was, that where an artery passing to the intestine was bleeding, he would advise not to ligate it, but to suture it to the intestine, as the bowel seemed to derive more nourishment from it. When a part of intestine has been cut by a bullet, he made an incision on each side of the wound large enough to admit a rubber ring, constructed of segments of drainage tube, strung on catgut. These two incisions were then approximated and the rings sewn together. The rings [*vide* MEDICAL TIMES, Vol. V., p. 497] are armed with four threads and needles, and when placed in position in the intestine, the opposing sutures, or threads, are tied, and coaptation sutures placed in between. The rings are left in and pass away by the bowel. There is no stricture to speak of, as the intestinal contents act as a dilator. The ring anastomosis was a success on the dog, but may not be so on the man, probably because the gut of the dog has more muscle. In case the mesentery was torn from the gut for an inch or more, he sewed it to the serous and muscular wall of the gut, care being taken not to carry the sutures clear through.

DR. JAMES SIMPSON asked if the animal's bowels were kept constipated before and after the operation, and if not, did he use an enema?

DR. CROWLEY said he kept the bowels constipated for six or seven days after, as peristalsis interfered with the healing of the wound. He used an enema when the wound was not in the colon.

DR. G. M. TERRILL inquired why the operator placed the first suture in the centre of the wound?

DR. CROWLEY said it acted as a guide and prevented the wound from pouting. In reply to Dr. Tait, he said, one row of sutures was sufficient.

DR. G. F. SHIELS said that by the old method three-quarters of an hour was frequently spent in looking for an intestinal wound, and even then it might not be found, but by the use of gas we find it in five minutes. The fluid simply brings out the bubbles. Suppose the wound was in the right iliac fossa or in some other deeply situated part of the cavity, if a median incision were made, the bubbles seen and followed up, how could the operator locate the wound precisely?

DR. CROWLEY said he would have to follow up the line of gas bubbles. This came directly from the wound and in a straight line. After suturing, the gut should again be inflated and submerged, to be certain of locating other wounds.

Dr. D. W. Montgomery said the elastic ligature suggested by Dr. Crowley was very ingenious; it was a great thing; it was easy to apply, did not hurt the gut and was quickly taken off. He congratulated Dr. Crowley on this.

Dr. George Gross said he had seen almost this method applied in *post-mortem* examinations as in pneumothorax, where the pleural cavity is filled with water and air is blown through the larynx; applied to intestinal wounds it was new.

Dr. Shiels said that the profession owed a debt of gratitude to Dr. Crowley. Lots of facts are known, but it took a good man to apply them. Dr. Crowley has been working for a long time on this subject, and what he says must be taken as definite and correct. There was one peculiar fact he wished to speak of: that was, if there were a growth such as cancer of the intestine, and an anastomosis is made removing the growth and a loop of intestine, the case would very surely end fatally. If the anastomosis were made and the loop left, the case would get along better. How this is he did not know. Was it from shock or from the amount removed?

Dr. F. J. Hund inquired whether the gas might not force fecal matter into the abdominal cavity? He also asked, was there not some danger of poisoning from the arsenic in the zinc that was used to generate the gas?

Dr. Crowley, in replying, said: The gas was so light that it did not expel fecal matter. He had, besides, never yet seen a wound of the intestine, especially a gun-shot wound, where the fecal matter had not escaped into the cavity. There was no danger from arsenical poisoning when using gas. He had never found the intestines so inflated after the sutures were in place as to prevent the abdomen from being closed. Even if they were, they could be manipulated. One year ago, at the meeting of the State Society, he took a loop out, made an anastomosis, ligated, and the loop below became atrophied and the ligature sloughed into the gut. He had removed one and two feet with recovery, and he thought several feet might be safely removed. If six feet were removed, he thought the shock through the sympathetic system was what killed. He believed that a cancerous growth, if limited to the intestine and mesentery, should be cut away. In conclusion, the speaker stated that in Oakland he had facilities for performing operations, and if any member of the Society would care to see any particular operation and would let him know a day or so in advance that he might procure a subject, he would gladly show anything in his power.